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CONSTRAINTS TO BIO-ENERGY DEVELOPMENT

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ABSTRACT

The energy crisis has prompted research and development of renewable, domestic, cost-effective and publicly acceptable energy alternatives. Among these are the bioconversion technologies. To date bio-energy research has been directed toward the mechanics of the conversion processes and technical assessment of the environmental impacts. However, there are other obstacles to overcome before biomass can be converted to more useful forms of energy that fit existing need. This paper identifies barriers to bio-energy resource application in the US. In addition, examples from several agricultural regions serve to illustrate site-specific resource problems.

1. INTRODUCTION

For more than a decade the US has been facing an uncertain energy future due to the continued need for increased importation of foreign oil. The dilemma has encouraged research into and development of domestic energy alternatives that are renewable, cost-effective and publicly acceptable. Among the alternatives being considered are the bioconversion technologies. These processes are designed to convert the solar energy trapped in plants, plant or animal residues, or grain into more useful forms of energy that fill existing needs. To date bio-energy research has been focused on the mechanics of the bioconversion processes, broad-brush analysis of the resource base to assess bio-energy potential, or identification of the technical aspects of possible environmental impacts. However, there are many other obstacles to overcome before these renewable resources can be realized as available energy alternatives. These constraints include social issues, technology adaptation, governmental regulations, and economic problems, considered separately or as they interact with each other.

2. SOCIAL ISSUES

Social deterrents can be diverse and powerful enough to prevent the deployment of a technology: witness the public's negative attitude toward the use of nuclear power. [1] Although biomass is hardly perceived by the public as an emittant of deadly effluents, there is the perception of this technology as a wasteful "burning of food." For example, many people believe that the alcohol fuel industry will compound the world hunger problem. Corn, the primary candidate for alcohol feedstocks, is used to feed animals in this

country, not people.* Although the price of corn-fed beef may increase, alcohol production will not affect the supply of the grains that are staples in the third-world countries: rice and wheat. World hunger is not, in reality, an issue; but the public attitude toward bio-energy as a threat to the hungry is.

Another deterrent is inadequate information transfer. Misinformation about new technologies can cause failure, creating a disinclination for further experimentation. Inaccessibility of commercially available tools, coupled with a generally suspicious attitude toward the new and untried, tend to inhibit development activity on the part of those involved in agriculture. Until the farmer is aware of, comfortable with and has access to commercially available bio-energy conversion components, there will be little activity.

The existing energy industry's attitude can also be an inhibition to bio-energy production. For example, although rural electrification cooperatives are in an excellent position to benefit from small, decentralized facilities, they have been slow to accept the challenge. [4] There is no active program to allow for on-the-grid access for farmers. In addition, an oil company representative presented a seminar to a House committee on the hazards of on-farm ethanol production. [5] Farmers are not encouraged by the utilities nor the oil companies to contribute to local energy supplies.

3. TECHNOLOGY ADAPTATION

There is also the problem of technology adaptation. The farming infrastructures in each of the many regions of the US have come about through an evolution of management practices. Machinery designs and orientation of activities are chosen to support an existing market. In order to gather residues for combustion, manure for gas, to plant extra acres in grain for ethanol, the farmer must alter his existing routine. Energy production will more likely occur when it dovetails with existing farming activity. An example of such a technology adaptation would be harvesting equipment that packages residue for direct combustion while grain is harvested.

Another technological problem is in matching the energy end-product and by-products to existing energy needs. For example, on-farm anaerobic digestion is a promising local energy resource. However, the technology for compressing, storing, and transporting the gas is not developed to provide for distribution of the resource throughout the community. The alternative, though not as energy efficient, is on-farm electrical generation. Electricity does fit the existing distribution grid.

4. GOVERNMENT REGULATION

There are powers inherent in local government to promote the general welfare. These powers are referred to as the police power and are subject to due process of law. [6] Through the police power, local governments have been given the right to regulate and control activities through zoning and permitting processes. Implementation of development activities

*Only 8% of the corn grown in the US is used for human consumption; [2] in addition, the protein is not lost in the process, the protein market may even be enhanced by the process. [3]

is subject to the local government attitude toward the interpretation of general welfare, which has proven to be very broad. [7] Although most people would agree that attainment of renewable energy at the local level may be in the best interest of community welfare, the law can and has been interpreted in such a way as to protect aesthetics and character of a community.[8] This interpretation could effect bio-energy facility siting, if the proposed site did not complement the existing "aesthetics and character."

In addition to states' power, the Federal Government has power to regulate interstate commerce, which has been interpreted to mean transport of any material including pollution, across state lines.* If neither a product nor its resulting pollution cross state lines, the states are responsible for enforcement. When the state is negligent with the enforcement, the EPA may force compliance with regulations. Table 1 gives a summary of applicable environmental regulations.

One example of a policy that might effect bioconversion is the Environmental Protection Agency, Best Management Practices (BMP). This is being carried out through US Department of Agriculture programs that stem from amendments to the 1972 Federal Water Pollution Control Act. This act authorizes cost sharing benefits to farmers who practice BMP for nonpoint water pollution abatement.** Although this is only an incentive program at this time, failure to comply may result in mandatory adoption of BMP.

Not all regulations inhibit implementation of local energy. For example, one regulatory tool for point sources water pollution abatement is the National Pollution Discharge Elimination System. The large feedlot waste disposal portion of this mechanism proposes guidelines for manure management. Criteria include options for control system performance. Unfortunately, methane generation is not included as a technique for manure management. If it were, funds normally expended to abate point source pollution could be diverted instead to energy production.

5. ECONOMICS

Economics plays a part in energy development. Farmers may encounter increased expense for control technologies to mitigate environmental impacts and for facility siting, for transport of residues, and for bringing new land into production. Baled residue on a per ton day, delivered, can cost as much as its equivalent in oil. The cost of using crop residues includes direct harvesting, transporting, and processing costs plus the indirect costs of loss of nutrients and cropping shifts. The economic feasibility of using residues also is tied to site-specific variables. Although the general use of residues in Iowa has proven to be marginal, [9] direct firing exclusively for grain drying is cost-effective. [10] Economic potential of bagasse and pineapple trash as alternative energy sources for Hawaii is very promising. [11] In addition, research and development into technologies which are most cost-effective will require financing.

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* (Confidential Source; personal communication by telephone, Environmental Protection Agency, July 1980.)

**(Rittall, Walt; Environmental Protection Agency, personal communication by telephone, June 1980.)

TABLE 1. APPLICABLE ENVIRONMENTAL REGULATIONS

Legislation	Applicant Pollutant or Residuals	Standards (Current or Proposed)	Possible New Standards
Clean Air	Particulate emissions from agricultural and silvicultural operations	Incinerators over 45 metric tons are presently regulated in Part 60, Sec. 60.5 .	Hydrogen sulfide, carbon dioxide, and ammonia are not specified in the Act as substances to be regulated; they may be included in State Implementation Plans. Ammonia, for instance, is a target pollutant in some states. NSPS will be developed for gasification.
NSPS	Gaseous residuals from thermochemical biomass conversion - carbon monoxide - particulates (PAH)		
PSD	Particulates Sulfur oxides	New sources emitting more than 100 tons per year of any pollutant regulated under the Act will require preconstruction permits in order to be built in PSD areas.	
Non-Attainment		Hydrogen sulfide is chemically reactive and converts to other compounds of sulfur, such as sulfur dioxide, which is a criteria pollutant. Thus, biomass emissions could contribute to raising ambient levels of sulfur oxides regionally.	
Visibility	Particulates		EPA will promulgate regulations for the control of emissions leading to impairment of visibility before mid-1979.
Clean Water	Runoff from forestry and agricultural residue area Liquid and solid residuals from the thermochemical biomass conversion - phenols - low-molecular-weight oils Dust and sediment loads, pollutants from runoff	NPDES permit required if discharging into navigable waters. EPA has issued guidelines identifying non-point sources of pollutants resulting from agricultural/silvicultural activities. 208 plans required from such region may have to be revised and may identify the major pollutants.	
RCRA	Sludge from anaerobic digestion, salts and heavy metals Ash and char residuals from thermochemical biomass conversion	EPA will establish a gradation of standards for hazardous and nonhazardous wastes. Similarly, landfill requirements have been released.	EPA will establish guidelines describing minimum performance levels for solid waste disposal and treatment practices for hazardous wastes.

TABLE 1 (cont.)

Legislation	Applicant Pollutant or Residuals	Standards (Current or Proposed)	Possible New Standards
RCRA (Cont)	Solid waste from biomass combustion-ash		
TSCA	Wood gas and pyrolysis oil possible byproducts		
SDWA	Sludge from anaerobic digestion-BOD, COD, salts and trace metals		
OSHA	Gaseous, liquid, and solid residuals from thermochemical and biochemical biomass conversion - hydrogen sulfide - carbon dioxide - carbon disulfide - sulfur oxides - cyanide - nitrogen oxides - ammonia - tar and oil products - organics and fine particulates (PAH) - biomass transportation and collection - pesticides from silvicultural and agricultural energy farms - operation of heavy equipment for production and harvesting		New sulfur dioxide and ammonia standards have been proposed. If accepted, these could increase the cost and difficulty of compliance.
FWCA	Endangered species habitat destruction Remnant ecotype destruction	Mitigation strategy required before project may proceed.	
OTHER	Water availability Aerial application of pesticides, fertilizers, and fire retardants	This technology requires substantial water use. Water availability may be constrained in various areas of country. The use of pesticides is controlled by the FPCA.	

Source: US Department of Energy: Environmental Development Plan Biomass Energy Systems, September 1979, p. 48-49.

Even though there is considerable land available for sugar production in Florida,* the land is expensive, and the process for converting cane to ethanol is not economically competitive with other sources.** It is labor-intensive and highly technical. Even if there were no competing uses for land in Florida or there existed a low-cost, low-technology solution to facility siting, the labor-intensive aspect of sugar production is a constraint. In fact, the US imported 17.2 million low cost gallons of alcohol from Brazil in April 1980. Brazil is fortunate in having low-cost labor and land. Because of local economic constraints the US is using another foreign source of energy, when the resource potential exists in this country. [12]

In order to accelerate development, the US Department of Agriculture (USDA) plans to finance bio-energy facility construction. There is an industry program that will allocate $100 million in 1981 for commercial-scale facilities. For the farmers program the USDA has allocated $10 million to fund on-farm applications.*** In each case, technical, environmental and operating criteria are reviewed in order to determine eligibility. Although this is a meager amount of money when compared to other energy development, it will provide demonstration programs. As other farmers and local lending institutions see the benefits of bioenergy, many more facilities will be constructed. There is a problem here again, however, with information. The farmer must be aware of the grant applications process.

6. SITE-SPECIFIC CONSTRAINTS

In addition to generic socioeconomic and technical deterrents to bio-energy production, there are site-specific problems that relate to resource availability. Although some areas of the country have ample biomass for energy, others do not. The reasons vary.

The Sunbelt has been experiencing a population boom. These newcomers may be full-time residents, attracted by the climate or business opportunities, or people who migrate in the winter. This influx of people creates a tug-of-war between various interest groups for land and water. Competition for land increases as need for recreation space, land for housing, or for the production of fresh produce, dairy products, and eggs increases. This conflict can affect the potential development of local energy from biomass in varied ways. For example, in Yolo County, California, an acre of asparagus can yield thousands of dollars. [13] Such economics prohibit displacing the vegetables with an acre of corn that would yield around 200 gallons of ethanol. [14] In other parts of the country, the generally increased price of land, even where this land may not be desirable for housing, prohibits its use as an energy producer. An example is Palm Beach County, Florida, where the muck lands used for sugar have tripled in price over the past decade. The sugar produced on this land is too expensive for alcohol production. In San Saba County, Texas, much land

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* (Hutchinson, Clayton; County Extension Agent, Palm Beach County, Florida, personal communication by telephone, May 1980.)

** Corn to ethanol will cost the consumer $.50 to $1.30 per gallon, sugar $2.07 to $2.30 per gallon. (Neenan, Bernie; Solar Energy Research Institute, personal communication by telephone, June 1980.)

***(Feld, David; Farmers Home Administration, US Department of Agriculture, personal communication by telephone, June 1980.)

is devoted to second homes or deer leases. The post oak forests, which are habitat for deer and turkey, also attract people from urban Houston or Austin. It is unlikely that the forests will be developed as a resource for direct combustion processes.

The existing use of a resource may also prohibit development. In Ashley County, Arkansas, and Yamhill County, Oregon, there are tremendous supplies of wood. With the exception of wood waste from the existing forest products industry, the wood is economically out of reach as an energy source because it is being sold for plywood and lumber.* In Lancaster County, Pennsylvania, the existing crop residues are used to help feed the huge livestock population. [15] In summary, simply because the land base or resource exists does not necessarily imply that the resource is available as a bio-energy feedstock.

7. CONCLUSION

Despite site-specific resource problems, the overall potential for converting biomass to energy is promising and conversion technology is available. There is a problem in matching existing energy needs with this potential, and there are many constraints to development. One could say that the US is experiencing an implementation crisis in addition to the energy crisis. Although biomass resources exist at the local level, development activity will be minor until constraints are mitigated. Bioconversion activity will be dispersed and will not contribute significantly to the overall reduction of dependence on foreign energy resources. However, if the agricultural sector is successful in initiating local information transfer and the legal, socioeconomic, and technological constraints to development are minimized, bioconversion will contribute significantly to local energy supplies.

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